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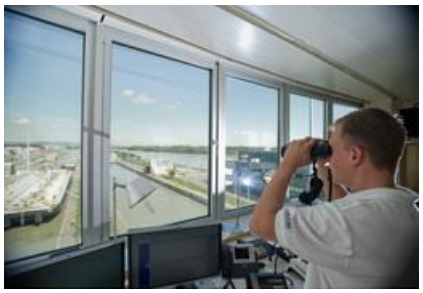


Research to advance the Development of River Information Services (RIS) Technologies

Final report
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1 Abstract

During the period of performance an intense study on the selection and prioritization of measures to advance the development of River Information Services (RIS) in the U.S. has been carried out which resulted in a comprehensive research report.
That report starts with an analysis of the status quo of RIS implementation in Europe. Both the legal as well as the technical framework are been presented and analyzed. Special attention has been given to the approach of "RIS-enabled Corridor Management" which is currently in the preparation phase for implementation. The status-quo analysis is accompanied with a separate inventory of national RIS initiatives in European member states in the annex of the document.
Next, the report presents an analysis of the framework for RIS in the U.S. with focus on the existing RIS capabilities and their relation to the international RIS Guidelines and standards. The status-quo analysis of RIS in the U.S. is completed by a summary of challenges related to development and operation of RIS on U.S. inland waterways.
Further focus has been put on the main research question whether and to what extent the European approach of "RIS-enabled Corridor Management" would also be applicable for the U.S. inland waterways.
One of the main chapters of the report describes possible implementation scenarios for RIS Corridor management in the U.S. Potential new services are identified and analyzed with respect to the necessary technical pre-requisites for implementation. For each service the status quo and an outlook for future actions are given.
Finally the identified new services and RIS capabilities are being prioritized according to the expected impact, the effort for implementation and the number of other depending services.
Aim of the report is to provide – based on the status quo of RIS in Europe in the U.S. – a catalogue of recommendations for future advancements together with a proposed prioritization.

2 Problem studied

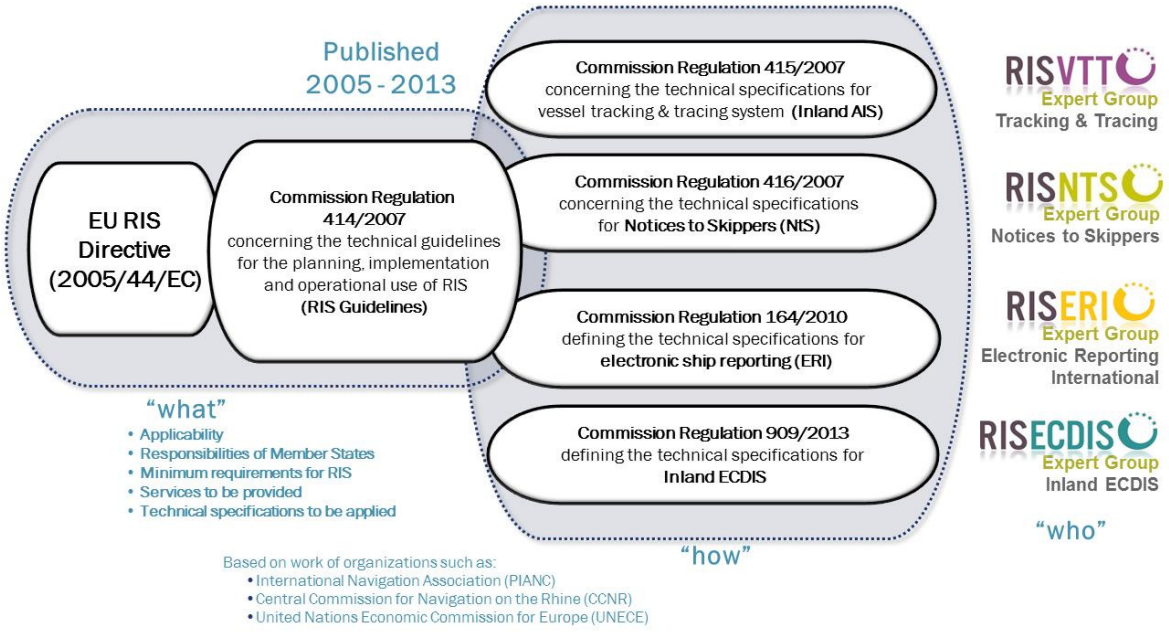
The U.S. Army Corps of Engineers (USACE) as the de-facto RIS Authority in the U.S. aims at introducing services to increase safety and efficiency of Inland Waterway Transport (IWT) and to increase the effectiveness of the operation of the waterways. The concept of RIS as defined in the PIANC RIS Guidelines provides a catalogue of basic services to support the abovementioned goals. However the development of RIS on international level has very much advanced in the recent years and new concepts like RIS-enabled Corridor Management have emerged.

In order to learn and benefit from the lessons-learned in designing, implementing and operating RIS in Europe, the USACE may want to build upon existing RIS experiences and lessons learned from Europe. Therefore the aim of the research was to compare RIS initiative in Europe and in the U.S. and to elaborate a catalogue of potential measures how to advance RIS in the U.S. in the upcoming years. The research took into account the different technical and legal environments on both continents and take into account the organizational situation in the U.S. and the existing capabilities.

3 Summary of results

3.1 Status quo of RIS in Europa and the U.S.

During the research first the situation of RIS in Europe has been analyzed. Through the so called "RIS Directive" Europe has set the legal and technical framework which guarantees harmonized implementation of RIS in all member states as well as a minimum set of services. The technical standards for the four RIS key technologies are elaborated and maintained by independent Expert Groups under the umbrella of the European Commission.



While AIS and IECDIS are used for tracking and tracing and chart display in Europe and the U.S., currently there are no technical counterparts for the Notices to Skippers and Electronic Reporting available in the U.S.

However in the past years, governmental agencies in the U.S. such as the USACE, US Coast Guard (USCG) and the National Oceanic and Atmospheric Administration (NOAA) have started several initiatives in the RIS environment. An overview can be found in the table below.

Owner	Name	Short description	RIS category	RIS technology
USACE	LOMA	Tool to increase situational awareness for lock operators; provide real-time information to vessel pilots. AIS-based capability	TM	AIS
USACE	LPMS	Collection of lock operations information to monitor inland waterways infrastructure performance	TM	Lock management, statistics
USACE	Masterdocks+	Inventory of inland waterway infrastructure locations and information (e.g. berths facilities, mile points, etc.)	FIS	RIS Index
USACE	CWMS	Corps Water Management System: System to access existing sources of data on water resources (e.g., stream gauges, water levels)	FIS	Water levels

		and make them available in a common way to USACE decision makers		
USACE	NTNI	Notices to Navigation Interests: Similar to USCG Notices to Mariners; issued by districts to provide information to vessel operators and navigation industry on waterway conditions (e.g., construction, operating restrictions, etc.)	FIS	NtS
USACE	IENCs	Production and publication of electronic navigational charts	FIS	IECNs
USCG	Notices to Mariners		FIS	NtS
CMTS/USCG	eMSI	Central, web-based provision of FIS information from multiple sources like the NTNI, Notices to Mariners or IENC updates.	FIS	Water levels, NtS, IENCs
USCG	SANS	Ship Arrival notification System	TM	Location based service
NOAA	Real-time tide and water level data	NOAA manages a network of 210 long term water level gauges that provide data 24x7 and data are updated every 6 minutes.	FIS	Water levels
NOAA	Real-time meteorological data	Wind speed and direction, air temperature, barometric pressure, visibility, relative humidity. Most water level stations also have meteorological sensors offering real-time coastal observations. NOAA's PORTS program also has several stand-alone meteorological stations.	FIS	Hydro-meteo information
NOAA	Real-time bridge air gap information	As part of the NOAA PORTS system, NOAA offers an air gap sensor that measures the distance between the bottom of a bridge and the water surface. This information is important for safe clearance under bridges.	FIS	Vertical bridge clearance

The analysis of the usage of the RIS key technologies in the U.S. revealed that many services use proprietary or non-standardized technologies which are hindrances to interconnectivity and data sharing among different capabilities.

	Inland AIS	Inland ENCs	Notices 2 Skippers	Electronic Reporting	Hull Database	RIS Index
LOMA	++	+	o	o	o	o
LPMS	o	o		++[1]	+[1]	o
NTNI			++[1]			
Navigation Notices			++[1]			
MasterDocks+						++[1]

Inland ENCs		++				
CWMS			++[1]			
eMSI		+	++[1]			++
RISE	+		+	++		

++ main technology used

\+ technology used

o technology could be used

[1] national standard, not compatible with EU RIS standards

Based on the analysis of the RIS environment in the U.S. a list of challenges on technical as well as on organizational level has been identified:

Technical:

- Absences of harmonized location codes
  RIS as provided today, lacks harmonized location codes ("RIS Index") which are used throughout all services. This harms the electronic usage of the current services, makes combination of services more complicated or less reliable and results in higher maintenance and harmonization efforts for the service providers.
- Decentralized Fairway Information Services
  Due to the provision of FIS over different websites, in different formats and without minimum set of data harms the usage of the information provided both by the users and by electronic applications.
- Absence of Electronic Reporting
  Since no electronic reporting system is in place, cargo and voyage reports are currently not available at all (but partially documented in the LPMS system). This hinders several potential services which are requiring such kind of information
- Opening towards industry users
  The current services are either fully available to the public (e.g. lock performance data, districts FIS sites) or not at all. However there a variety of (potential) services which are dealing with sensitive data which is of great value to industry users. For the current status of available service the access to AIS vessel data may be interesting to industry users. Neither the systems nor the governance of these systems currently allows for dynamic access rights to RIS data.

Organisational/Operational:

- Lack of a RIS Authority
  The provision of RIS is currently done through the USACE and the USCG within their day-to-day work, based on the initiatives of a few individuals. Though there is an overarching e-Navigation strategy issued by the CMTS, a detailed and clear mission describing the aim, tasks and responsibilities with respect to development and operation of RIS is still missing. Even within the USACE, there's not one single authority which can influence the related activities within the Corps. Different districts, institutes and labs are acting through informal cooperation which is sometimes influenced by local needs.
- Agreed RIS standards for the US
  Other than the EU which builds on published standards for RIS, there's no officially agreed technical basis for the implementation of RIS in the US. Though world-wide standards are taken as a basis (e.g. Inland ECDIS and AIS), they are not formally agreed. Standards for FIS and electronic reporting are missing. Also supporting standards like the RIS Index or a publication of used codes and formats are not available today.

- Dedicated budget for RIS implementation and operation
  The sustainable implementation of RIS needs to follow an agreed plan. In order to plan effectively a mid- to long-term planning basis is of utmost importance. Therefore the necessary multi-annual funds need to be agreed in order to make sustainable decisions.
- Staffing
  Implementing nation-wide services which are linked to each other in order to provide an added value to all users needs the rights people to plan and manage the related work. Since the technical basis is constantly evolving and the user demands are changing it takes the right amount of skilled people. While the Nation-wide AIS (NAIS) effort of the USCG seems to have the minimum staffing, the RIS team at USACE is – from an objective point of view – grossly understaffed[1]. This bears the high risk that money, time and know-how is being lost and that the initial goals will not be fully achieved.

3.2 Applicability of RIS-Corridor Management in the U.S.

RIS-enabled Corridor Management deals with the use of RIS for the effective and safe provision of services, individually adapted to the local needs of a certain area. An important aspect of RIS-enabled Corridor Management is the interoperability of the underlying components for the provision of useful end-user services. The concept comprises services on three different levels:

- Level 1: Services enabling route planning (pre-trip planning)
- Level 2: Services related to traffic management and voyage planning (on-trip management)
- Level 3: Services for logistics (third party usage)

Based on the generic RIS-Corridor Management concept an inventory of potential advanced RIS capabilities for the U.S. has been elaborated. This inventory describes the purpose and function of each service, relates to relevant existing capabilities and provides and outlook on what needs to be done to implement the service in the future.
The overview of services is presented in the following table.

Name of the service	Short description	Dependent on	US project addressing this
RIS Service Directory	The RIS Service Directory is an aggregator which links to different data sources and provides centralized access to multiple data streams. It is targeting 3rd party services which build on existing capabilities.	Underlying web services.	RISE framework development
RIS Data Clearance Center	The service monitors the data coming from different data sources (e.g. AIS/LOMA, LPMS etc.) and checks for inconsistencies. In case of detection the information about data inconstancies they are then automatically reported to trigger the related actions to have the data being corrected. Obvious or systematic errors may be auto-corrected.	Underlying services Vessel Database	USCG AVIS, or other data validation service (not existing)
Nationwide FIS	The service provides centralized and har-	Underlying ser-	Enhanced Marine

[1] Most countries in Europe have dedicated staff for RIS development of around 5-10 people working both national and in the European RIS Expert Groups. In addition separate staff is dealing with RIS operation.

	monized information of all fairway-related information like water depths, shallow section information, IENC data including IENC updates, AIS AtoNs, Notices to Skippers, bridge clearance, traffic regulation, light signals etc.	vices RIS Index	Safety Information (eMSI)
Position Service	The service provides information about the position of any vessel/convoy which is known to any national AIS/VTS system. The service is critical to user rights; the access is typically role-based.	LOMA, NAIS, RIS Index	LOMA, NAIS
Traffic Information Services	The service provides (anonymized) information about statistical usage, current traffic densities and usage of the waterway infrastructure and allows for estimation of traffic-related delays en-route.	LOMA, NAIS, LPMS, RIS Index	LPMS
ETA Service	The service monitors the status and progress of voyages which have been reported electronically and actively informs about changes of the ETA in case of detected deviations so far and forecasts and changes of the influence parameters ahead.	LOMA, NAIS, LMS, voyage reporting system	Vessel time travel analysis
Voyage Planner	The voyage planner combines the functionality of a route-planner and travel time calculator and allows to estimate voyage times, pre-announce at stops incl. locks and to negotiate timeslots for passage or mooring. The voyage planner also makes use of the deviation service and creates updates of the voyage plan incl. already negotiated time slots at infrastructure in case of deviations.	LOMA, NAIS, LMS, ETA, voyage reporting system	Electronic reporting of voyage information from industry
Efficiency Planner	The efficiency planner allows for optimization of planned routes or routes currently under voyage based on actual influence parameters, especially actual fairway conditions and traffic situation. The efficiency planner provides recommendations for reduction of fuel consumption and exhaust gases related to caused delays of the voyage (if any).	LOMA, NAIS, LMS, ETA, voyage reporting system	
Lock Management Service	The Lock Management Service is capable of coordinating lock planning in a chain of locks, taking into account vessel/convoy characteristics, voyage reports, actual and statistical traffic and the availability of the infrastructure.	LOMA, NAIS, LPMS, voyage reporting system	
Single Reporting	The Single Window allows for centralized	RIS Index	Electronic report-

Window (Cargo & Voyage)	electronic reporting of cargos and ideally also voyages. The electronic submission of cargo and voyage reports is the basis for smart traffic management and almost all value added services.		ing
Cargo Tracker	The cargo tracker is a service where vessel/cargo owner and/or logistics partners can monitor the position of a vessel/cargo based on access rights. The cargo tracker also informs about the latest ETA information. The cargo tracker also has intermodal interfaces.	LOMA, NAIS, ETA, electronic cargo reporting system, voyage reporting system	Electronic reporting
Berth/Terminal Occupation Service	The berth/terminal service provides and overview of current usage of (public) berths or terminals and provides indications about future usage based on statistical data and/or reservations. The system may also provide the possibility to reserve berth/terminal space.	LOMA, NAIS, ETA, voyage reporting system	[Industry system(s)]
Industry Portal	The Industry Portal combines the service for industry users at one central location.	RIS Index, FIS, TIS, LOMA, NAIS, ETA, electronic cargo and voyage reporting system	Electronic reporting, RISE
Waterway Operator Services	The WOS service provides tailor-made tools for waterway operators. Examples are the management of (virtual) AIS AtoN, the monitoring of dredging operations as well as numbers and performance of usage of the infrastructure resulting in key performance indicators (KPIs).	LOMA, NAIS, RIS Index, IENCs, TIS	[individual internal and external systems]

3.3 Recommendations

Finally the report presents recommendations based on the input of the previous chapters.
On the one hand recommendations for the adaptation of the legal framework for RIS in the U.S. are given. They mainly suggest the introduction of a legal instrument to create a 'governance' of RIS beyond agencies. Also the setup of working groups to elaborate binding minimum standards for the RIS key technologies and to involve users more closely into the development of RIS are suggested.

On the other hand technical recommendations on the prioritization (what) and next steps (how) to implement advanced services and improved capabilities are presented, including the identification of involved stakeholders and related existing capabilities.
The following table shows the final overview table of prioritized measures.

Measure	type of actions required			impact	effort	dependencies	priority	related organisations	existing capabilities
	stand.	imp.	reg.	10=highest	10=least	1=low, 3=high	300=highest		
RIS Index for the US inland waterways	X	x		9	7	3	189	USACE, USCG, FILS/FINDE	eMSI, Masterdocks+
Centrally accessible, coded Notices	x	X	x	8	5	3	120	USACE, USCG	eMSI
Online reference data management system	x	X		6	6	3	108	USACE, USCG	eMSI, Masterdocks+
Electronic Reporting system	x	X	x	10	3	3	90	USACE, USCG	BargeEx
Use of ECS on inland waterways	x		X	8	10	1	80	USCG, RTCM	NVIC 01-16
RIS Directory	x	X		8	4	2	64	USACE, USCG	RISE
Centrally eMSI information	x	X		6	5	2	60	USACE	eMSI, RISE, eHydro, CWMS
Central hull database for inland vessels	x	X	x	6	4	2	48	USACE, USCG	USCG vessel database
Guidelines for the display of AIS in ECS	X			5	8	1	40	USACE, USCG, RTCM	
Extension of the AIS coverage		X		6	3	2	36	USACE, USCG	LOMA, NAIS
Traffic Information Services	x	X		6	6	1	36	USACE	
ETA service	x	X		5	6	1	30	USACE	
Voyage Planning Service	x	X		8	3	1	24	USACE	
Data Clearance Service	x	X		6	3	1	18	USACE, USCG	AVIS
Enhanced Lock Management Service	x	X	x	8	2	1	16	USACE	LOMA, LPMS

4 Publications

The research only created one output document named “RIS Development on US waterways - Research to advance the Development of River Information Services (RIS) Technologies”.
This comprehensive report covers all aspects of the research and has been elaborated under the supervision of the US Army technical representative.

5 Research Personnel involved

The research has been mainly carried out by Mr. Juergen TROEGL MSc. who has a 16 years record of working in the development and implementation of RIS. He's been following the RIS implementation in the U.S. since 2010 and is active member of several international organizations and working groups.
Juergen Troegl has been supported in the research by the following colleagues who contributed in their specific fields of expertise:

- Dr. Michael FASTENBAUER (International activities)
- Mr. Mario KAUFMANN MSc. (European Hull Database)
- Mr. Adam KUCSERA MSc. (IECS, Navigation Support Services)
- Mr. Johannes NEMETH MSc. (IENCS, Reference Data Management)
- Mr. Christoph PLASIL MSc. (Notices to Skippers, FIS, Reference Data Management)
- Mr. Mario SATTLER MSc. (RIS-enabled Corridor Management)
- Mr. Andreas SCHERB MSc. (International Data Exchange and logistics services)
- Mr. Thomas ZWICKLHUBER MSc. (Traffic and Lock Management)

No advanced degrees were earned during the employment in the project.